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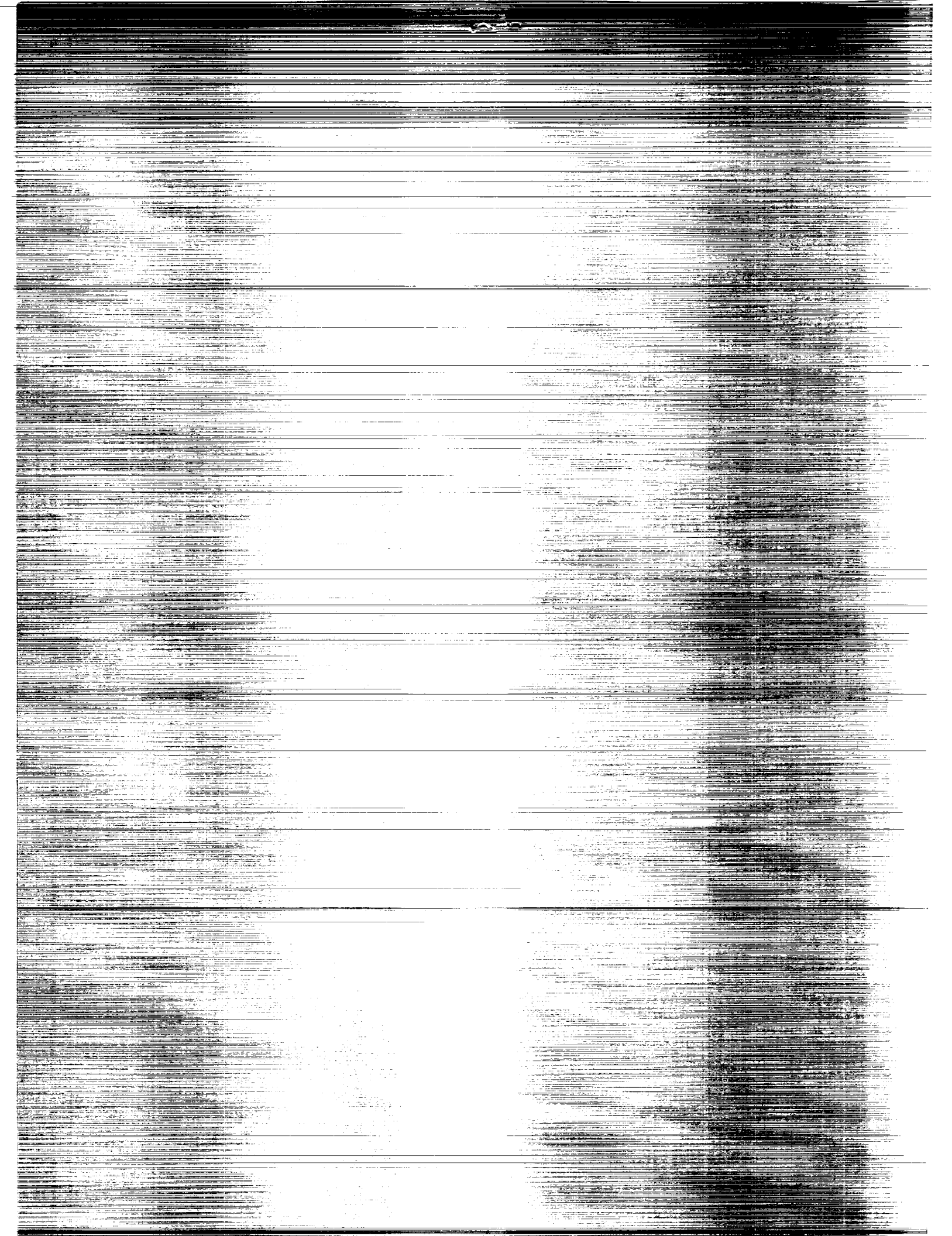
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PREFACE

Space medicine research of the Life Sciences Division, located within the Office of Space Science and Applications of the National Aeronautics and Space Administration, was established to investigate the major physiological, medical, and psychological problems encountered by man as he undertakes space flight. Research in this area seeks to obtain a better definition of each problem and understanding of its underlying mechanisms, and ultimately, a means of resolution and prevention. Programs that support this research are: Space Physiology and Countermeasures, including the disciplines of cardiopulmonary, musculoskeletal, neuroscience, and regulatory physiology; Space Human Factors; Environmental Health; Radiation Health; and Clinical Medicine.

This bibliography contains publications published in 1987 and 1988 resulting from ground-based and flight research supported by these programs. This is the fifth edition in a series of bibliographies of space medicine research. Previous editions in this series cover the years 1980-1982 (NASA CR 3587), 1982-1983 (NASA CR 3739), 1983-1984 (NASA CR 3860), and 1984-1986 (NASA CR 4184).

As part of our continuing interaction with the scientific extramural community, we are pleased to present this bibliography in an effort to stimulate an exchange of information and ideas among scientists working in the different areas of the programs.

We would like to thank the investigators for their cooperation in submitting lists of their publications. We would also like to thank Janice S. Wallace, Janet V. Powers, Katherine J. Dickson, April C. Roy, and F. Ronald Dutcher of GWU for their editorial and technical expertise in the compilation of this bibliography.

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INTRODUCTION

The objective of NASA's Life Sciences programs in space medicine research is to understand — and ultimately to overcome — the physiological, psychological, and sociological obstacles to extended human space flight. The development of suitable countermeasures to physiological deconditioning, protocols to optimize crew performance and productivity, and operational life support systems is critical to achieving this goal.

Programs in this area are Space Physiology and Countermeasures, Space Human Factors, Environmental Health, Radiation Health, and Clinical Medicine. This research is targeted towards four major problems that could threaten to limit the duration of human stays in space: physiological deconditioning, exposure to space radiation, human factors issues inherent in long-term flight, and maintenance of a habitable environment. Basic and applied research is conducted using human subjects, animal models, computer modeling and analog environments and is focused on determining the mechanism of action of space-related effects.

The overall objective of the Space Physiology and Countermeasures Program is to understand the effects of microgravity on the various physiological systems and to develop countermeasures to ameliorate detrimental effects. The program is subdivided into four research disciplines: cardiopulmonary, musculoskeletal, neuroscience, and regulatory physiology. The goals of the cardiopulmonary discipline are to understand the mechanisms of cardiovascular changes that occur in real and simulated weightlessness and upon return to the gravitational environment, and to develop countermeasures, where desirable, to these changes. Specific changes include orthostatic intolerance and aerobic deconditioning upon return to gravity, and a potential increased frequency of cardiac arrhythmias during space flight. Research in the musculoskeletal discipline is designed to understand the mechanisms of musculoskeletal changes that occur with real and simulated weightlessness, including muscle atrophy and bone demineralization; to determine acute and long-term responses and health consequences of exposure to microgravity; and to develop and verify countermeasures to reduce the effects of microgravity on the musculoskeletal system and facilitate readaptation to Earth's gravity. The principal objectives of the neuroscience discipline are to understand how sensory information from biological transducers is converted to neural impulses, how these impulses are processed, and how they lead to a motor (behavioral) output. Understanding is sought of acute and long-term neurosensory adaptation to space, in order to develop adequate physiological and performance countermeasures. Ground-based research in support of these goals includes study of mechanisms of the otoliths, semi-circular canals, related reflexes, central nervous system function, and postural control. Research is also being conducted on the causes and correlation of space motion sickness. The regulatory physiology discipline seeks to determine and understand the integrative mechanisms regulating responses to space flight in the following areas: circadian rhythms, fluids and electrolytes, endocrinology, pharmacodynamics, metabolism and nutrition, hematology, and temperature regulation. Research is designed to investigate operational factors and basic mechanisms of adaptation to space flight and to develop possible countermeasures for impaired adaptation.

The goals of the Space Human Factors Program are to develop the knowledge base required to understand behavioral adaptation to space flight — both acute and long-term — and the capabilities and limitations of the crewmembers in the unique environments that will be encountered on future long-duration missions. This requires an in-depth understanding of psychological and behavioral adaptation to space and the ways in which adaptive behaviors influence or affect performance. Particular attention has been paid to identifying and optimizing psychological, psychophysiological, social and behavioral factors which affect the attainment of mission objectives. The program also develops and validates system design requirements, protocols, and countermeasures that ensure the psychological well-being, safety, and enhanced productivity of

space crewmembers. Another area of focus has been the collection of anthropometric data on performance and the integration of such data into models that can predict performance in space. The Environmental Health Program conducts research in three areas: toxicology, microbiology, and pressure and gas compositions. The focus is on both risk assessment and characterization of the spacecraft environment for air and water quality as well as microbial and chemical contamination, all of which may affect crew health.

The Radiation Health Program is designed to understand the biological effects of space radiation and improve evaluation of radiation-induced risks to crew members. Specific areas being studied include molecular-level mechanisms involved in radiation-induced cell transformation and the relationship between mutations and lethal damage caused by radiation. In addition, protection from radiation hazards is being investigated.

The Clinical Medicine Program's goals are to ensure the health and safety of flight crewmembers, prevent an unnecessary rescue, and to increase the probability of success of a necessary rescue. These objectives are being pursued through longitudinal retrospective and prospective studies which attempt to relate changes in physiology and/or pathology to specific factors associated with individual traits of the astronauts and occupational exposure and through a modular inflight medical system known as the Health Maintenance Facility which will provide preventive, diagnostic, and therapeutic capabilities for Space Station.

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*Asterisk denotes Principal Investigator

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